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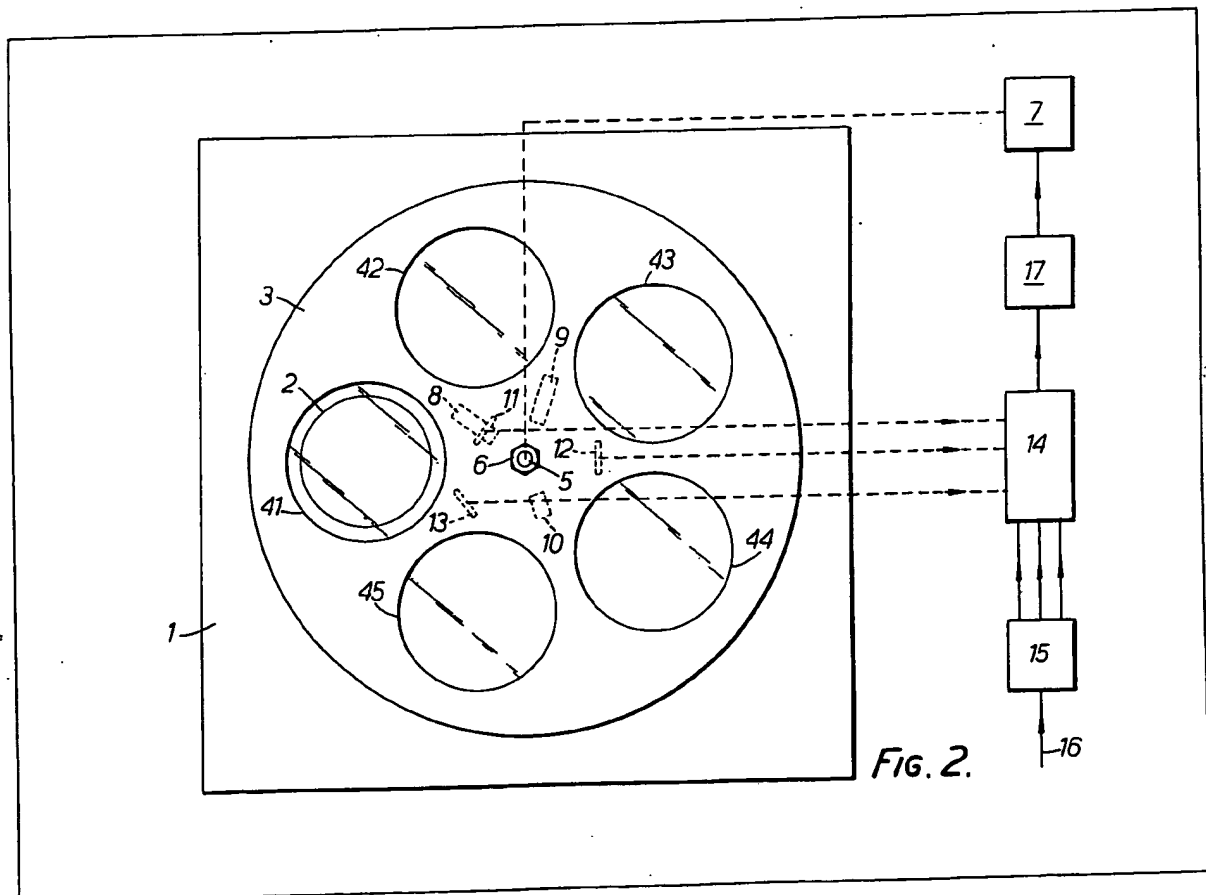
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(54) Control of theatre apparatus,  
for example lights

(57) A theatre apparatus, such as a

luminaire, includes a part (3), such as a colour wheel, which can be moved between two or more discrete desired positions to alter the condition of the apparatus, one or more magnetic parts (8,9,10) mounted on the moving part and, sensing means (11,12,13), such as magnetically operated reed switches, mounted on the apparatus on a stationary part adjacent the path of the moving part. In each of said two or more discrete desired positions of the moving part the sensing means (11,12,13), in response to the position of the magnetic parts (8,9,10), adopts a different characteristic state indicative of the position of the moving part. The magnetic parts (8,9,10) are directly mounted on the effect so that they are sure to give a true indication of the position of the effect. The sensing means could comprise Hall effect devices or the magnetic system replaced by an optical, or an inductive, system.



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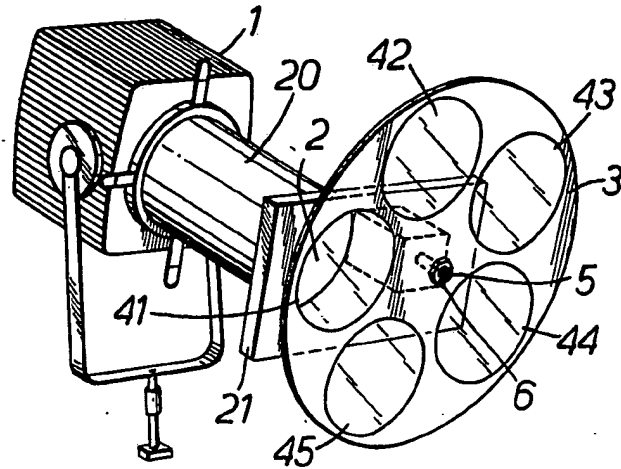


FIG. 1.

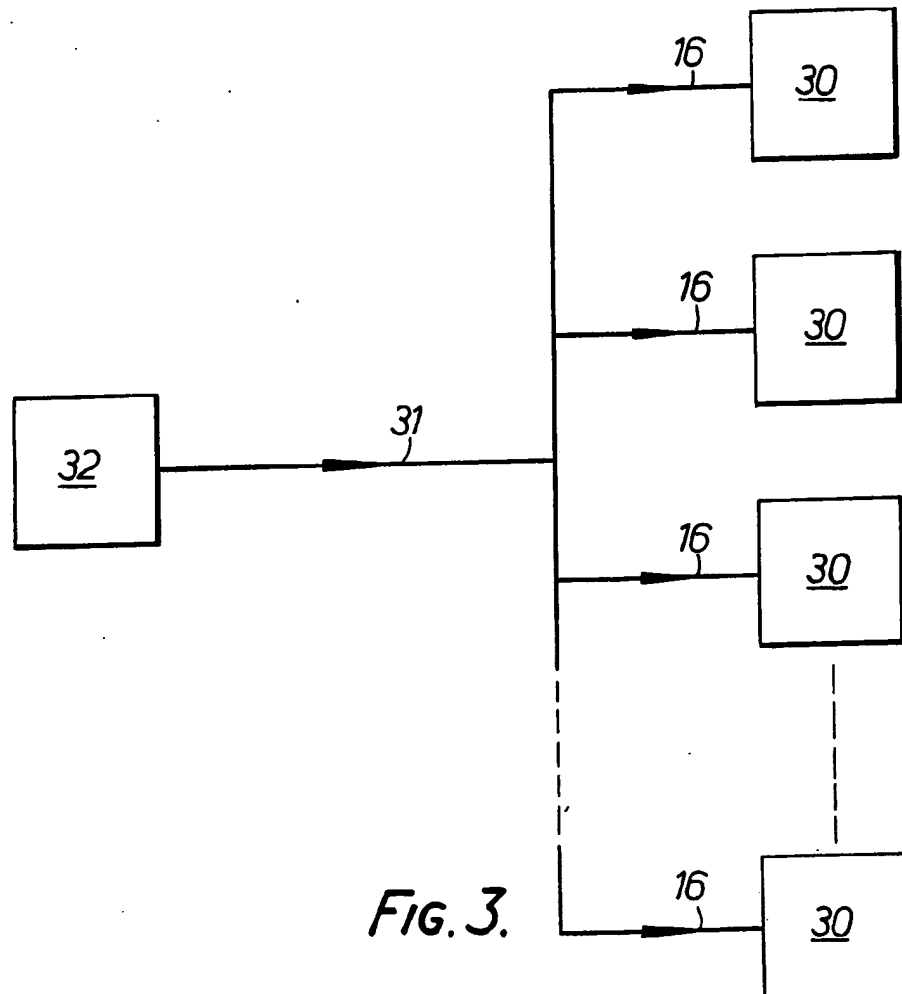


FIG. 3.

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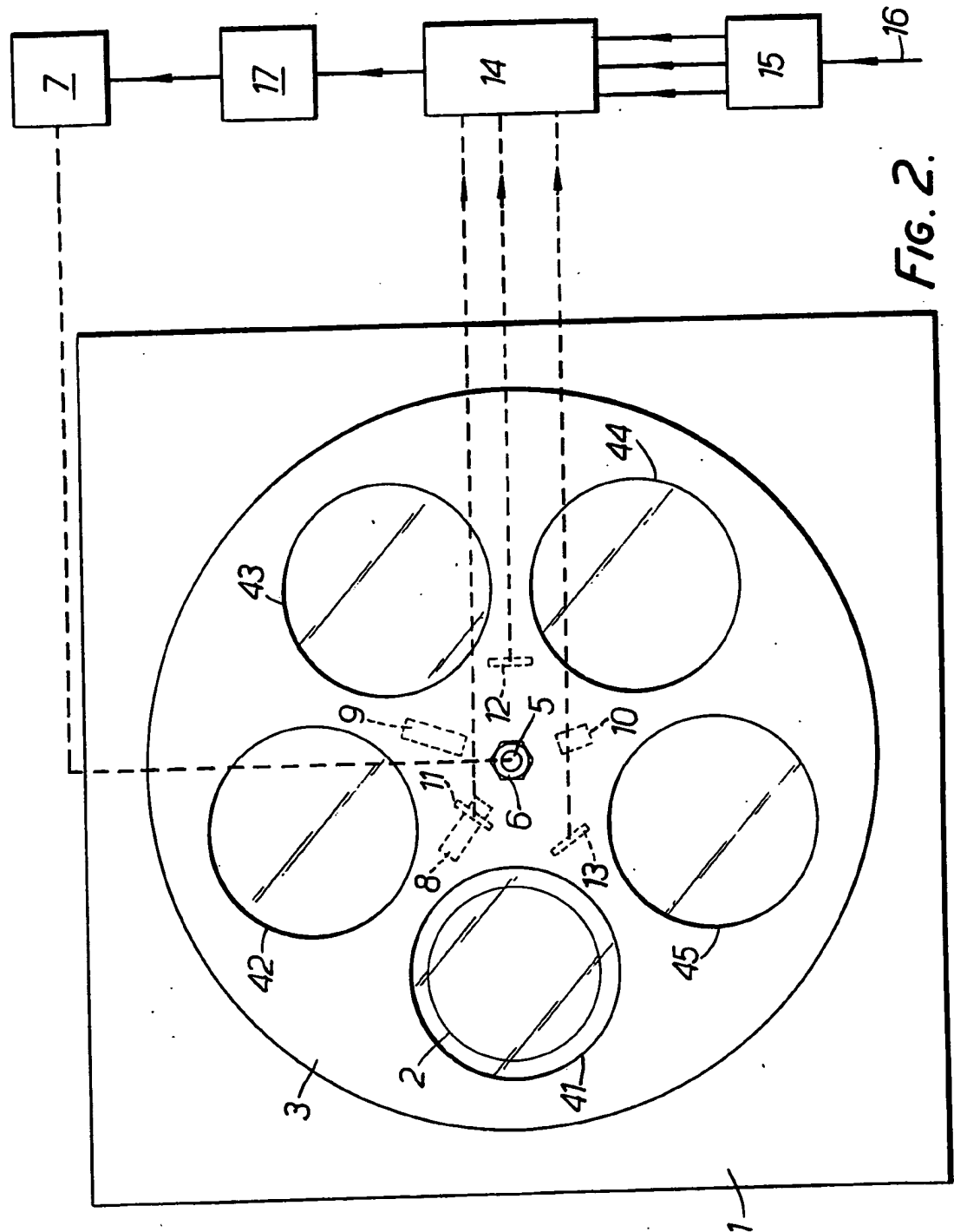


FIG. 2.

## SPECIFICATION

### Control of theatre apparatus, for example lights

5 This invention relates to apparatus for use in theatre lighting and other theatre apparatus in which the position of a movable part is to be controlled. The invention has particular reference to the control of effects with luminaires, especially for the control of a colour wheel in front of a light. 5

It is well known to provide a theatre spotlight with a colour wheel. The colour wheel has a plurality of different filter elements spaced therearound and a selected one of these can be brought in front of the light output upon rotation of the colour wheel to the appropriate position. It is known to control of colour wheel 10 remotely by the following arrangement: the colour wheel is fixed by a nut to a shaft on which is mounted a switch contact which, upon rotation of the shaft, rotates and makes wiping contact with a series of switch contacts disposed around the shaft in a plane perpendicular to the axis of the shaft. Commonly the switch is a wafer switch. An associated switch contact is provided for each filter element and the desired filter element 15 is selected by driving the motor until the associated switch contact makes wiping contact with the switch contact of the shaft. 15

An arrangement of the kind above enables an operator to control the position of the colour wheel from a remote control centre, but it has certain disadvantages. Each switch contact has to be electrically connected to the control centre so that for a five colour wheel six conductors, apart from any power cables to the 20 spotlight, must be laid between the control centre and the luminaire. This makes installation expensive both in terms of the amount of cable required and the time required to set up the spotlight. Also the mechanical switch is likely to become dust-ridden and if for any reason the colour wheel is forced to rotate backwards the switch may be damaged. 20

Another difficulty arises if the colour wheel rotates relative to the shaft. In this case the colour wheel will not stop with the correct filter element aligned with the light output. Also if the colour wheel is removed from 25 the shaft care must be taken to replace the wheel in the correct orientation on the shaft. 25

Apart from the nuisance of having to adjust the colour wheel there is also a safety hazard often associated with any maintenance or adjustment of the light since lights are frequently in somewhat inaccessible places.

According to one aspect of the invention a theatre apparatus including a part which can be moved between two or more discrete desired position to alter the condition of the apparatus has one or more 30 magnetic parts mounted on the moving part for signalling the position of the moving part and sensing means mounted on the apparatus on a stationary part adjacent the path of the moving part, the arrangement being such that in each of the two or more discrete desired positions of the moving part the sensing means, in response to the position of the magnetic parts, adopts a different characteristic state indicative of the 35 position of the moving part. 35

The use of magnets rather than switch contacts to sense the position of the moving part is advantageous since they are unaffected by dust and are not prone to mechanical wear or damage.

The magnetic parts are preferably mounted in permanent fixed relationship to the moving part and may be directly mounted on the moving part rather than, for example, being mounted on a shaft to which the 40 moving part is fixed. The use of magnets facilitates a mounting arrangement of this kind which is advantageous since it ensures that the position of the magnets gives an accurate representation of the position of the moving part. 40

According to another aspect of the invention a theatre light includes an effect movably mounted over the output of the light, means for moving the effect between discrete desired positions in which different 45 selected parts of the effect are positioned over the output of the light to affect the output according to the position of the effect, one or more magnetic parts mounted on the effect for signalling the position of the effect, and sensing means mounted on a stationary part of the light adjacent the path of the effect, the arrangement being such that in each of the discrete desired position of the effect the sensing means, in response to the position of the magnetic parts, adopts a different characteristic state indicative of the 50 position of the moving part. 50

The advantage of magnets that have already been discussed are of particular value for a theatre light because of the difficulty and degree of hazard involved in maintenance of the light.

The effect may be rotatably mounted and may include a colour wheel. The magnetic parts may be mounted on the wheel itself, thereby ensuring that the position of the magnetic parts gives an accurate 55 representation of the position of the wheel. 55

The sensing means may comprise one or more magnetically operated switches, for example reed switches, the arrangement being such that in each desired position of the effect, the switch states of the switches are different. The number of switches and magnetic parts required will depend upon the number of desired positions of the effect. In the simplest case, with two desired positions, one magnetic part and two 60 switches are sufficient. Where there are five desired positions, for example with a five colour wheel, five magnetic parts may be provided on the wheel and three switches adjacent the wheel, three of the magnetic parts being at one radial distance from the centre of the wheel and arranged with the first and second parts spaced apart by about one fifth of a revolution and the third part spaced from the other two by about two 65 fifths of a revolution, the other two magnetic parts being at another radial distance from the centre of the wheel and spaced apart by about one fifth of a revolution. Conveniently said other two parts may be formed 65

as continuations of the first and second parts; this arrangement facilitates assembly of the effect. The switches are arranged with one switch on about the same radius as the first, second and third magnetic parts and the other two switches on about the same radius as the other two magnetic parts and spaced apart by about one fifth of a revolution.

- 5 An arrangement of switches and magnets as defined above provides a simple and cheap arrangement which can give a binary output indicative of the position of the effect. 5

According to a further aspect of the invention a theatre light includes an effect movably mounted over the output of the light in which the movable effect includes a member selected parts of which can be positioned over the output of the light to affect the output according to the position of the effect, means for moving the effect between discrete desired positions in which different selected parts of the member are positioned over the output of the light, signal means mounted on the member and in permanent fixed relationship to the member for signalling the position of the member, and sensing means mounted on a stationary part of the light adjacent the path of the effect, the arrangement being such that in each of the discrete desired positions of the member the sensing means, in response to the position of the signal means, adopts a different characteristic state indicative of the position of the member. 10 15

The effect or moving part may be driven by an electric motor. Control means may be provided in which a signal from the sensing means is compared with a predetermined signal selected by an operator and the motor is stopped when the signal from the sensing means and the predetermined signal are in a desired relationship. The control means may be located at or in the apparatus and a single conductor for carrying an input signal from an operator provided. The use of a single conductor to control the effect saves considerably on installation costs and reduces installation time. 20

The invention also provides a theatre installation including a plurality of apparatuses and/or lights as defined above and a central control unit, each apparatus and/or light including a control means as defined above, each control means being connected to the central unit and arranged to receive predetermined signals from the control unit. 25

In particular the invention provides a theatre installation including a plurality of theatre apparatuses and a central control unit,

each theatre apparatus including a part which can be moved between two or more discrete desired positions by a motor to alter the condition of the apparatus, one or more magnetic parts mounted on the moving part for signalling the position of the moving part and sensing means mounted on the apparatus on a stationary part adjacent the path of the moving part, the arrangement being such that in each of said two or more discrete desired positions of the moving part the sensing means, in response to the position of the magnetic parts, adopts a different characteristic state indicative of the position of the moving part, and a control means which is connected to the central control unit and in which a signal from the sensing means is compared with a predetermined signal received from the control unit and the motor is stopped when the signal from the sensing means and the predetermined signal are in a desired relationship. 30 35

Said plurality of control means may be connected to the central control unit along a common control channel. An address signal may be sent from the central control unit with each predetermined signal. The signals from the central control unit may be carried along a power line to the apparatuses and/or lights. 40

By way of example, an illustrative embodiment of the invention will now be described with reference to the accompanying drawings, of which:

*Figure 1* is a perspective view of a luminaire embodying the invention,

*Figure 2* is a schematic front view of the luminaire, and

*Figure 3* is a block diagram showing a number of luminaires according to Figures 1 and 2 connected to a common control unit. 45

Referring to Figures 1 and 2 a luminaire which may be a theatre spotlight, has a body 1 having a tubular front portion 20 carrying a plate 21 at its front end, a lens 2 through which light is emitted and a colour wheel 3 having five separate filter elements 41, 42, 43, 44 and 45. The colour wheel 3 is fixed to a shaft 5 extending out of the plate 21 by a nut 6 and can be rotated by the shaft so as to bring a selected one of the filter elements over the lens 2. The shaft 5 is drivingly connected to a motor 7 housed in a box 22 attached to the back of the plate 21, via a friction clutch if desired. 50

On the rear face of the colour wheel 3 there are three magnetic strips 8, 9 and 10. Strip 8 is disposed with its longitudinal axis on a radial line passing midway between filter elements 41 and 42, strip 9 is disposed with its longitudinal axis on a radial line passing midway between filter elements 42 and 43, and strip 10 is disposed with its longitudinal axis on a radial line passing midway between filter elements 44 and 45. The inner ends of the strips are equispaced from the centre of the colour wheel but the strips 8 and 9 are twice the length of the strip 10 so that their outer ends terminate further from the centre of the colour wheel than the outer end of the strip 10. 55

Mounted on the plate 21 of the luminaire are three reed switches 11, 12 and 13. The reed switches lie on the front face of the plate adjacent to the rear face of the colour wheel 3. With the colour wheel in the position shown, namely with the filter element 41 aligned with the lens 2, the switch 11 lies on a radial line passing midway between the filter elements 41 and 42, the switch 12 lies on a radial line passing midway between the filter elements 43 and 44 and the switch 13 lies on a radial line passing midway between the elements 45 and 41. The switches 12 and 13, which are equidistant from the shaft 5, are the same distance from the axis of rotation of the colour wheel as the outer portion of the strips 8 and 9 while the switch 11 is the same distance 60 65

from the axis of rotation as the strip 10.

The states of the switches 11, 12 and 13 provide a three bit binary input to the comparator 14 according to an input signal on line 16. An output from the comparator is passed to a delay circuit 17 and then used to control the motor 7 which drive the shaft 5.

In use a signal is sent along the line 16 from a central control unit. The signal is decoded by the decoder 15 into a three bit binary output and is passed to the comparator 14 where it is compared with the three bit binary output from the reed switches 11, 12, 13. When both binary inputs are the same a signal is passed to the delay circuit 17 and after a short delay the motor 7 is stopped; when the binary inputs are different the motor is actuated and the colour wheel 3 rotates relative to the body 1.

In the position shown in Figure 2 (position A), the reed switch 11 is aligned with the magnetic strip 8 and is therefore closed (binary output '1'), while the reed switches 12 and 13 are not aligned with any magnetic strip and therefore open (binary output '0'). If the colour wheel 3 is now rotated one fifth of a revolution anti-clockwise so that the filter 42 is aligned with the lens 2 (position B), the reed switch 11 becomes out of alignment with any magnetic strip and therefore opens (binary output '0') and the reed switch 12 moves into alignment with the magnetic strip 9 and therefore closes (binary output '1'). The reed switch 13 moves onto the same radius as the magnetic strip 10 but is further from the centre of rotation than the strip 10 and therefore the switch 13 remains open (binary output '0'). Further rotation of the colour wheel aligns the lens 2 with, first the filter 43 (position C), then the filter 44 (position D) and finally the filter 45 (position E). Still further rotation returns the colour wheel to its original position (position A).

In each of the positions the binary output of the switches is different as shown in the table below:

<i>Position</i>	<i>Binary output of switch 13 2<sup>2</sup></i>	<i>Binary output of switch 12 2<sup>1</sup></i>	<i>Binary output of switch 11 2<sup>0</sup></i>
A	0	0	1
B	0	1	0
C	0	1	1
D	1	0	0
E	1	0	1

From the table above, it will be seen that the binary output of the switches progresses from a binary output of one for the position of the colour wheel shown in the drawing up to a binary output of five for position E. When the colour wheel is between two positions all the switches are open giving a binary output of zero.

When the colour wheel is not being used but is connected to a power supply the input signal on line 16 is such that the binary output from decoder 15 is zero. Accordingly the motor is actuated until the switches 11, 12, 13 are all open which happens as soon as a filter elements moves out of alignment with the lens 2, whereupon the motor stops.

If now another signal is applied on line 16, for example one which when decoded provides a binary output of three the two inputs to the comparator 14 will no longer be the same, the motor will be actuated and the colour wheel will rotate until the switches 11, 12 and 13 provide a binary output of three, that is until the colour wheel reaches position C. As the colour wheel approaches position C and switch 11 closes so the comparator passes a signal to the delay circuit 17 indicative of the matching of its inputs. After a short delay the circuit 17 stops the motor. The provision of the delay circuit 17 prevents false stopping of the motor owing to a transient signal.

The position of the colour wheel is therefore determined by which of six input signals are applied on line 16. The decoder 15, comparator 14, delay circuit 17 and motor 7 are normally located in the box 22 of the luminaire but are shown outside the luminaire for the sake of clarity.

The input signal on the line 16 may be carried on a separate conductor or may be superimposed on a power line to the luminaire.

The use of magnets and reed switches is especially advantageous since they are simple but reliable devices and their operation is not affected by normal dust and would not be seriously affected were the colour wheel to become buckled for example. As alternatives, however, it would be possible to use Hall effect switches instead of reed switches, or the magnetic system could be replaced by an optical or inductive system.

Since the magnetic parts are permanently fixed directly to the colour wheel, they inevitably give an accurate indication of the position of the colour wheel, even if the colour wheel is incorrectly located on the shaft.

In the embodiment described the motor drives the central shaft on which the colour wheel is located but other forms of drive could be used for example the rim of the colour wheel could be driven by frictional

engagement of a wheel driven by the motor.

Although in the described embodiment there are three magnetic strips, the magnetic strips 8 and 9 each effectively consist of two strips, an inner strip and an outer strip. Thus each of the magnetic strips 8, 9 could be replaced by two separate magnetic strips and the radial distance of the outer ones of these strips from the axis of rotation could be increased or reduced provided the radial distance of the switches 12 and 13 were correspondingly altered; furthermore these outer strips could be shifted around the axis of rotation provided they were shifted equally and provided the switches 12 and 13 were correspondingly shifted.

If a colour wheel with a different number of filter elements is provided then a different arrangement of switches and magnets may be desirable. The precise arrangement will of course vary according to the number of filter elements.

Although the invention has been described with particular reference to colour wheels for luminaires it may be applied to the control of a moving part of any apparatus for producing a theatrical effect.

If desired, a number of luminaires may be connected to the same central control unit and controlled by signals multiplexed on a common control line. Such an arrangement is illustrated in Figure 3 in which luminaires 30, each being as described with reference to Figures 1 and 2 are connected through spur lines 16 to a common control line 31 which is, in turn, connected to a central control unit 32. In this case the decoder 15 of each luminaire is arranged to decode only a position signal accompanied by the address of that particular luminaire. The addressing of the luminaire may be by another signal or merely by the time band in which the signal appears. Where two or more luminaires are to operate in unison, they share the same address. Thus it will be clear that a large number of luminaires can all be controlled from a common control unit along a common line. This greatly reduces cable cost and assembly time, the latter being particularly important on tour.

In the described embodiment the magnetic strips are located on the colour wheel on radial lines passing midway between the filter elements. The position of the magnetic strips can however be varied provided the position of the reed switches is correspondingly varied. For example the reed switches could be shifted clockwise around the body so that the switch 13 becomes aligned with the lens 2 and the magnetic strips would then be fixed to the colour wheel on radial lines passing through the centres of the filter elements.

#### CLAIMS

1. A theatre apparatus including a part which can be moved between two or more discrete desired positions to alter the condition of the apparatus, one or more magnetic parts mounted on the moving part for signalling the position of the moving part and sensing means mounted on the apparatus on a stationary part adjacent the path of the moving part, the arrangement being such that in each of said two or more discrete desired positions of the moving part the sensing means, in response to the position of the magnetic parts, adopts a different characteristic state indicative of the position of the moving part.

2. An apparatus according to claim 1 in which the magnetic parts are mounted in permanent fixed relationship to the moving part.

3. An apparatus according to claim 2 in which the magnetic parts are mounted directly on the moving part.

4. A theatre light including an effect movably mounted over the output of the light, means for moving the effect between discrete desired positions in which different selected parts of the effect are positioned over the output of the light to affect the output according to the position of the effect, one or more magnetic parts mounted on the effect for signalling the position of the effect, and sensing means mounted on a stationary part of the light adjacent the path of the effect, the arrangement being such that in each of the discrete desired positions of the effect the sensing means, in response to the position of the magnetic parts, adopts a different characteristic state indicative of the position of the moving part.

5. A theatre light according to claim 4 in which the effect is rotatably mounted and includes a colour wheel.

6. A theatre light according to claim 5 in which the magnetic parts are mounted on the wheel itself.

7. A theatre light according to any of claims 4 to 6 in which the sensing means comprises one or more magnetically operated switches, the arrangement being such that in each desired position of the effect, the switch states of the switches are different.

8. A theatre light according to claim 7 in which the effect is rotatably mounted and includes a five colour wheel to be moved between five discrete desired positions, in which five magnetic parts are provided on the wheel and three switches adjacent the wheel, three of the magnetic parts being at one radial distance from the centre of the wheel and arranged with the first and second parts spaced apart by about one fifth of a revolution and the third part spaced from the other two by about two fifths of a revolution, the other two magnetic parts being at another radial distance from the centre of the wheel and spaced apart by about one fifth of a revolution, the switches being arranged with one switch on about the same radius as the first, second and third magnetic parts and the other two switches on about the same radius as the other two magnetic parts and spaced apart by about one fifth of a revolution.

9. A theatre light according to claim 8 in which said other two magnetic parts are formed as continuations of the first and second parts.

10. A theatre light according to any of claims 4 to 9 in which the effect is driven by an electric motor.

11. A theatre light according to claim 10, further including control means in which a signal from the sensing means is compared with a predetermined signal selected by an operator and the motor is stopped when the signal from the sensing means and the predetermined signal are in a desired relationship.
12. A theatre light according to claim 11 in which the control means is located at or in the light and a single conductor for carrying an input signal from an operator is provided.
13. A theatre light including an effect movably mounted over the output of the light in which the movable effect includes a member selected parts of which can be position over the output of the light to affect the output according to the position of the effect, means for moving the effect between discrete desired positions in which different selected parts of the member are positioned over the output of the light, signal means mounted on the member and in permanent fixed relationship to the member for signalling the position of the member, and sensing means mounted on a stationary part of the light adjacent the path of the effect, the arrangement being such that in each of the discrete desired positions of the member the sensing means, in response to the position of the signal means, adopts a different characteristic state indicative of the position of the member.
14. A theatre installation including a plurality of theatre apparatuses and a central control unit, each theatre apparatus including a part which can be moved between two or more discrete positions by a motor to alter the condition of the apparatus, one or more magnetic parts mounted on the moving part for signalling the position of the moving part and sensing means mounted on the apparatus on a stationary part adjacent the path of the moving part, the arrangement being such that in each of said two or more discrete desired positions of the moving part the sensing means, in response to the position of the magnetic parts, adopts a different characteristic state indicative of the position of the moving part, and a control means which is connected to the central control unit and in which a signal from the sensing means is compared with a predetermined signal received from the control unit and the motor is stopped when the signal from the sensing means and the predetermined signal are in a desired relationship.
15. A theatre installation according to claim 14 in which said plurality of control means are connected to the central control unit along a common control channel.
16. A theatre light substantially as herein described with reference to as and illustrated by Figures 1 and 2 of the accompanying drawings.
17. A theatre installation substantially as herein described with reference to and as illustrated by Figures 1, 2 and 3 of the accompanying drawings.